Table 3: Ecological Zone: Alluvial River-Floodplain Ecosystem.		
Habitat (continued)	Water/sediment quality	■ Toxicity -- concentrations in water and sediment -- tissue concentrations -- bioassays -- biomarkers -- bioindicators -- contaminant loading ■ Dissolved oxygen ■ Turbidity-suspended solids ■ Temperature ■ Nutrients (N, P, C)
Biological Communities	Community Structure	■ Trends in the abundance, diversity, composition, and distribution of riparian insect assemblages, by functional group ■ Trends in the abundance, diversity, composition, and distribution of benthic invertebrate assemblages by functional group ■ Trends in abundance, reproductive success, diversity, composition, and distribution of native resident and migratory birds ■ Trends in the abundance, diversity, composition, and distribution of native mammals ■ Trends in distribution, diversity, and structural complexity of native plant associations ■ Trends in abundance, diversity, composition, distribution and trophic structure of natives fishes ■ Invasive introduced species -- measures of new invasions -- abundance, spatial extent and distribution of selected species -- number of selected species eradicated or exhibiting no net increase in distribution ■ Population trends of selected listed species ■ Fish and wildlife health
Community Energetics/ Nutrient Cycling	Nutrient and energy supply	■ Ratio of floodplain to river production ■ Export of organic materials from floodplain to river channel ■ Percent increase in dissolved N and P after overbank flows ■ Concentrations of dissolved N and P in groundwater at selected sites

Table 4. Ecological Zone: Delta

Ecosystem Geographic Scope: The Delta is the easternmost (upstream) portion of the estuary, and today is clearly delimited by a legal boundary that includes areas that historically were intertidal, along with supra-tidal portions of the floodplains of the Sacramento and San Joaquin Rivers. Today's legal Delta extends between the upper extent of the tidewater (near the city of Sacramento on the Sacramento River and Mossdale on the San Joaquin River) and Chipps Island to the west, and encompasses the lower portions of the Sacramento and San Joaquin river-floodplain systems as well as those of some lesser tributaries (Mokelumne and Calaveras rivers). The Sacramento and San Joaquin Rivers enter the Delta from the north and south respectively, where they join and together discharge their contents near the western margin of the Delta.

INDICATOR TYPE	ATTRIBUTE	INDICATORS
Hydrologic/ Hydrodynamic	Positive seaward flow	■ Delta outflow
	Spatial and temporal salinity patterns	■ Salinity at selected locations throughout the Delta
	Water circulation	■ Composite measures -- freshwater flow rates -- water residence time -- flow direction for selected channels ■ Flows of tributaries mimic pattern of unimpaired flow
Geomorphic	Flat topography	■ Difference in percent of area flooded during MHHW versus MLLW
	Dendritic distributary channel patterns	■ Linear distance of channels per unit area ■ Proportion of first, second, and third order channels per unit area
	Channel morphology	■ Bank slope
	Physical connectivity	■ Connectivity of riverine channels to wetlands
	Sediment production and acquisition	■ Marsh plain elevation relative to sea level ■ Change in area of Delta islands and islets
Habitat	Habitat mosaic and connectivity	■ Extent and distribution of patches of all natural habitat types ■ presence and distribution of species requiring multiple habitats ■ Presence and distribution of migratory fish species ■ Number of unnatural barriers interfering with natural movements of native species, water flow, sediment transport and supply, and nutrient transport

Table 4. Ecological Zone: Delta		
Habitat (continued)	Water/sediment quality	■ Toxicity ■ Concentrations in water and sediment -- tissue concentrations -- bioassays -- biomarkers -- bioindicators -- contaminant loading ■ Dissolved oxygen ■ Turbidity-suspended solids ■ Temperature ■ Nutrients (N, P, C) ■ Salinity/TDS
Biological Communities	Community Structure	■ Trends in abundance, diversity, composition, and distribution of native phytoplankton and zooplankton assemblages ■ Trends in the abundance, diversity, composition, and distribution of benthic invertebrate assemblages ■ Trends in abundance, reproductive success, diversity, composition, and distribution of native resident and migratory birds ■ Trends in the abundance, diversity, composition, and distribution of native mammals ■ Trends in distribution, diversity, and structural complexity of native plant associations ■ Trends in abundance, diversity, composition, distribution and trophic structure of native resident and anadromous fishes ■ Cohort replacement and survival rates of selected life stages of certain fish ■ Invasive introduced species -- measures of new invasions -- abundance, spatial extent and distribution of selected species -- number of selected species eradicated or exhibiting no net increase in distribution ■ Population trends of selected listed species ■ Fish and wildlife health
Community Energetics/ Nutrient Cycling	Plankton productivity	■ Primary production rates ■ Abundance of zooplankton
	Benthic invertebrate production	■ Secondary production of zoobenthos
	Net transport/export of detrital organic matter from marshes to other habitats	■ Flux of detrital organic matter
	Variable sources of nutrient loading to the Bay	■ Nutrient loading

Table 5. Ecological Zone: Greater San Francisco Bay.

Ecosystem Geographic Scope: Greater San Francisco Bay, as defined here, is that part of the estuary between Chipps Island and the Golden Gate. It includes four major embayments: Suisun Bay and Marsh, San Pablo Bay, and central and south San Francisco Bay.

INDICATOR TYPE	ATTRIBUTE	INDICATORS
Hydrologic/ Hydrodynamic	Freshwater inflow	■ X2 location ■ Salinity at selected locations throughout Bay
	Spatial and temporal salinity patterns	■ Salinity at selected locations throughout Bay ■ X2 location
	Hydrodynamics	■ Water movement and vertical mixing at select locations throughout Bay
Geomorphic	Sediment supply	■ Net sediment accretion rate relative to rate of sea-level rise at subtidal and intertidal sites ■ Elevation at appropriate fixed sites in marshes and mudflats throughout Bay. Compare to sea level
Habitat	Habitat mosaic and connectivity	■ Extent and distribution of patches of all natural habitat types ■ Presence and distribution of species requiring multiple habitats ■ Presence and distribution of migratory fish species ■ Number of unnatural barriers interfering with natural movements of native species, water flow, sediment transport and supply, and nutrient transport
	Water/sediment quality	■ Toxicity -- concentrations in water and sediment -- tissue concentrations -- bioassays -- biomarkers -- bioindicators -- contaminant loading ■ Dissolved oxygen ■ Turbidity-suspended solids ■ Nutrients (N, P, C) ■ Salinity/TDS

Table 5. Ecological Zone: Greater San Francisco Bay.		
Biological Communities	Community Structure	■ Trends in abundance, diversity, composition, and distribution of native phytoplankton and zooplankton assemblages ■ Trends in the abundance, diversity, composition, and distribution of benthic invertebrate assemblages ■ Trends in abundance, reproductive success, diversity, composition, and distribution of native resident and migratory birds ■ Trends in distribution, diversity, and structural complexity of native plant associations ■ Trends in abundance, diversity, composition, distribution and trophic structure of native resident and anadromous fishes ■ Invasive introduced species -- measures of new invasions -- abundance, spatial extent and distribution of selected species -- number of selected species eradicated or exhibiting no net increase in distribution ■ Population trends of selected listed species ■ Fish and wildlife health
Community Energetics/ Nutrient Cycling	Plankton productivity	■ Phytoplankton productivity ■ Zooplankton productivity
	Benthic invertebrate production	■ Benthic invertebrate productivity
	Net transport/export of detrital organic matter from marshes to other habitats	■ Flux of detrital organic matter

Table 6. Attributes of Alluvial River Ecosystems	
Attribute	**Rationale**
Spatially Complex Channel Morphology	No single segment of channelbed provides habitat for all species, but the sum of all channel segments provides high-quality habitat for native species. A wide range of structurally complex physical environments supports diverse and productive biological communities.
Flow and Water Quality are Predictably Variable	Inter-annual and seasonal flow regimes are broadly predictable, but specific flow magnitudes, timing, duration, and frequencies are unpredictable because of runoff patterns produced by storms and droughts. Seasonal water quality characteristics, especially water temperature, turbidity, and suspended sediment concentration, are similar to those of regional unregulated rivers and fluctuate seasonally. This temporal "predictable unpredictability" is a foundation of river ecosystem integrity.
Frequently Mobilized Channelbed Surface	Channelbed framework particles of coarse alluvial surfaces are mobilized by the bankfull discharge which occurs on average every 1 to 2 years.
Channelbed Scour and Fill	Alternate bars are scoured deeper than their coarse surface layers by floods exceeding 3- to 5-year annual maximum flood recurrences. This scour is typically accompanied by re-deposition, such that net change in channelbed topography following a scouring flood usually is minimal.
Balanced Fine and Coarse Sediment Budgets	River reaches export fine and coarse sediment at rates approximately equal to sediment inputs. The amount and mode of sediment storage within a given river reach fluctuates, but channel morphology is sustained in dynamic quasi-equilibrium when averaged over many years.
Periodic Channel Migration	The channel migrates at variable rates and establishes meander wavelengths consistent with regional rivers with similar flow regimes, valley slopes, confinement, sediment supply, and sediment caliber.
A Functional Floodplain	On average, floodplains are inundated once annually by high flows equaling or exceeding bankfull stage. Lower terraces are inundated by less frequent floods, with their expected inundation frequencies dependent on norms exhibited by similar, but unregulated river channels. These floods also deposit finer sediment onto the floodplain and low terraces.
Infrequent Channel-Resetting Floods	Single large floods (e.g., exceeding 10- to 20-year recurrences) cause channel avulsions, widespread rejuvenation of mature riparian stands to early-successional stages, side channel formation and maintenance, and off-channel wetlands (e.g., oxbows). Resetting floods are as critical for creating and maintaining channel complexity as are lesser magnitude floods.
Self-Sustaining Riparian Plant Communities	Natural woody riparian plant establishment and mortality; based on species life history strategies, culminate in early- and late-successional stand structures and species diversities (canopy and understory) characteristic of self-sustaining riparian communities common to regional unregulated river corridors.
Naturally-Fluctuating Groundwater Table	Inter-annual and seasonal groundwater fluctuations in floodplains, terraces, sloughs, and adjacent wetlands occur in a manner similar to that in regional unregulated river corridors.

Source: B. Trush and S. McBain. 1999. McBain & Trush. Attributes of alluvial ecosystems. Appendix H in: Trinity River Flow Evaluation Final Report. A report to the Secretary of the Interior. U.S. Fish and Wildlife Service. June 1999.

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◆ VISIONS FOR ECOSYSTEM ELEMENTS

The Strategic Plan for Ecosystem Restoration provides the scientific and practical framework for restoring the Bay-Delta watershed. The Strategic Plan guides the planning by providing 6 Strategic Goals which bound the scope of ecosystem restoration and numerous Strategic Objectives which provide more detailed direction and a basis by which to determine whether or not progress is being made toward achieving the respective goal. The majority of the goals are presented in terms of management or restoration actions designed to have a favorable impact on the Bay-Delta ecosystem and watershed.

This section provides the species designations which are consistent with the MSCS. The section also provides an ERP vision for each of the ecosystem elements (ecological processes, habitats, species, and stressors). Each vision is a snapshot of what the ERP intends to accomplish during the long-term implementation program.

SPECIES DESIGNATIONS

The Multi-Species Conservation Strategy (MSCS) addresses all federally and State listed, proposed, and candidate species that may be affected by the CALFED Program; other species identified by CALFED that may be affected by the Program and for which adequate information is available also are addressed in the MSCS. The term "evaluated species" is used to refer to all of the species addressed by the MSCS. Please refer to the MSCS appendix (Multi-Species Conservation Strategy 1999) for more information and for a complete list of evaluated species.

The MSCS also identifies 18 NCCP habitat types. These are broad habitat categories, each of which includes a number of habitat or vegetation types. The NCCP habitats are as follow:

- Tidal perennial aquatic
- valley riverine aquatic
- montane riverine aquatic
- lacustrine
- saline emergent
- tidal freshwater emergent
- nontidal freshwater emergent
- natural seasonal wetland
- managed seasonal wetland
- valley/foothill riparian
- montane riparian
- grassland
- inland dune scrub
- upland scrub
- valley/foothill woodland and forest
- montane woodland and forest
- upland cropland, and
- seasonally flooded agricultural land.

The following is a discussion and definition of each of the five species designations used in the ERP. These designations have evolved during the development of the ERP. The present set of designations differs from designation previously presented in the ERP. Table 7, following the designation descriptions, provides a crosswalk of previous designations and how they are related to the present designations.

RECOVER

RECOVERY "R": For species designated "R," the CALFED Program has established a goal to recover the species within the CALFED ERP Ecological Management Zones. A goal of "recovery" was assigned to those species whose recovery is dependent on restoration of the Delta and Suisun Bay/Marsh ecosystems and for which CALFED could reasonably be expected to undertake all or most of the actions necessary to recover the species. Recovery is achieved when the decline of a species is arrested or revered, threats to the species are neutralized, and the species; long-term survival in nature is assured.

Recovery is equivalent, at a minimum, to the requirements of delisting a species under FESA and CESA. Certain species, such as anadromous fish, have threats outside the geographic scope or purview of CALFED (e.g., harvest regulated under the Magnuson-Stevens Act). Therefore, in some instances CALFED may not be able to complete all actions potentially necessary to recover the species; however, CALFED will implement all necessary recovery actions within the ERP Ecological Management Zones. For other species, CALFED may choose a goal that aims to achieve more than would be required for delisting (e.g., restoration of a species and/or its

habitat to a level beyond delisting requirements). The effort required to achieve the goal of "recovery" may be highly variable between species. In sum, a goal of "recovery" implies that CALFED is expected to undertake all actions within the ERP Ecological Management Zones and Program scope necessary to recover the species.

Contribute to Recovery

Contribute to Recovery ("r"): For species designated "r," the CALFED Program will make specific contributions toward the recovery of the species. The goal "contribute to recovery" was assigned to species for which CALFED actions affect only a limited portion of the species range and/or CALFED actions have limited effects on the species.

To achieve the goal of contributing to a species' recovery, CALFED is expected to undertake some of the actions under its control and within its scope that are necessary to recover the species. When a species has a recovery plan, CALFED may implement both plan measures that are within the CALFED Problem Area, and some measures that are outside the Problem Area. For species without a recovery plan, CALFED will need to implement specific measures that will benefit the species.

Maintain

Maintain ("m"): For species designated "m," the CALFED will undertake actions to maintain the species. This category is less rigorous that "contribute to recovery." The goal "maintain" was assigned to species expected to be minimally affected by CALFED actions. For this category, CALFED will avoid, minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species. Actions may not actually contribute to the recovery of the species; however, at a minimum, they will be expected to not contribute to the need to list a species or degrade the status of a listed species. CALFED will also, to the extent practicable, improve habitat conditions for these species.

Enhance and/or Conserve Biotic Communities

Enhance and/or Conserve Biotic Communities ("E"): For those communities designated "E," the ERP will undertake actions to conserve and enhance their diversity, abundance and distribution in a manner that contributes to their long-term sustainability without adversely affecting efforts to improve conditions for other at-risk species.

Maintain and/or Enhance Harvested Species

Maintain and/or Enhance Harvested Species ("H"): For those species designated "H" the CALFED Program will undertake actions to maintain the species at levels which support or enhance sustainable harvest rates. The goal "maintain harvested species" was generally assigned to species which are harvested for recreational or commercial purposes and which are not already covered under one of the four previous designations. A key to maintaining harvestable surplus levels is to recognize the need to recover, contribute to recovery, or maintain other species. Thus, species interactions such as competition and predation and habitat needs for space and flow need to be balanced in favor of species designated for recovery, contribute to recovery and maintain. Those three designations apply only to native species and assemblages while the "maintain harvested surplus" species include some native species and non-native species. Thus, actions implemented to maintain harvestable surplus would be expected, *at a minimum*, to not contribute to the need to list an unlisted species, degrade the status of an already listed species, or impair in any way efforts to recover, contribute to recovery, or maintain native species.

MSCS Conservation Measures

The MSCS defines "conserve, conserving, and conservation" as the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to ESA and CESA are no longer necessary. These methods and procedures include, but are not limited to, all activities associated with scientific resources management, such as research, census, law enforcement, habitat acquisition, restoration and maintenance, propagation, live trapping and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot

be otherwise relieved, may include regulated taking (Multi-Species Conservation Strategy 2000).

Two types of conservation measures were developed under the MSCS: 1) measures designed to avoid, minimize, and compensate for CALFED's adverse effects on NCCP communities and evaluated species (applicable to species with "R," "r," and "m" conservation goals; and 2) measures to enhance NCCP communities and evaluated species that are not directly linked to CALFED's adverse impacts. The majority of measures designed to enhance NCCP communities and evaluated species incorporate and refine existing ERP and other CALFED actions. The scope, location, and timing of a particular CALFED Program action or group of actions, as well as the current status, distribution, and needs of the affected species, will determine which conservation measures would be necessary to compensate for adverse impacts. NCCP habitat conservation measures are primarily directed at conserving the quality and quantity of natural habitats.

Generally, measures to avoid, minimize and compensate adverse effects are addressed early in site-specific project development and are specific components of the project. The identification of additional enhancement measures are more global in nature and developed to provide additional detail to ERP programmatic actions.

An important addition to this version of the ERP is the inclusion of specific conservation measures that provide additional levels of detail to ERP programmatic actions. These conservation measures were designed specifically for MSCS evaluated species. This version of the ERP displays throughout Volumes I and II where the conservation measures fit and support existing programmatic actions.

Volume I of the ERP is structured by 1) ecological process, 2) habitat, 3) species, and 4) stressors. Generally, few conservation measures were developed specifically for ecological processes, some habitats and stressors were emphasized in the conservation measures, and most species are directly addressed in one or more conservation measures.

The conservation measures that add detail to ERP programmatic actions are from Attachment 5 of the MSCS.